## AMENDMENTS TO THE CLAIMS

Sub B1

1. A digital circuit for shifting a frequency band of a signal vector to a predetermined frequency band, wherein the signal vector is determined by a pair of I (in-phase) and Q (quadrature) components on I-Q plane, comprising:

a control data generator for generating control data from a frequency difference between the frequency band and the predetermined frequency band; and

a signal vector rotator for rotating the signal vector on the I-Q plane by an angle determined depending on the control data to produce an output signal vector in the predetermined frequency band.

A1

2. The digital circuit according to claim 1, further comprising:

an analog-to-digital converter for converting a received analog signal vector to the signal vector according to a predetermined sampling clock,

wherein the control data generator comprises:

a phase data generator for generating phase data from the frequency difference in synchronization with the predetermined sampling clock; and

a converter for converting the phase data to the control data consisting of a plurality of control bits.

3. A digital circuit according to claim 2, wherein the signal vector rotator comprises:

a plurality of partial rotators which are connected in series in descending order of a rotation angle, wherein each of the partial rotators receives a different bit of the control bits of the control data and rotates an output of a

previous stage by a predetermined angle depending on a corresponding control bit received from the converter.

4. A digital circuit according to claim 2, wherein the phase data generator generates the phase data by computing an integral multiple of a unit angle which is obtained from a frequency shift per period of the predetermined sampling clock.

5. A digital circuit for shifting a plurality of frequency bands of input signal vectors to a predetermined center frequency band to produce an output signal vector for each frequency band, wherein each of the input signal vectors is determined by a pair of I (in-phase) and Q (quadrature) components on I-Q plane, comprising:

Cont A1

an analog-to-digital converter for converting analog signal vectors to the input signal vectors according to a predetermined sampling clock;

a control data generator for generating control data from a frequency difference between each of the plurality of frequency bands and the predetermined center frequency band;

a signal vector rotator corresponding to each of the plurality of frequency bands, for rotating the input signal vectors on the I-Q plane by an angle determined depending on corresponding control data to shift the frequency bands of the input signal vectors to the predetermined center frequency band; and

a band-pass filter corresponding to the signal vector, for receiving an output of the signal vector rotator and passing an output signal vector of the predetermined center frequency band.

6. The digital circuit according to claim 5, wherein the control data generator comprises:

a phase data generator for generating phase data Φ from the frequency difference in synchronization with the predetermined sampling clock; and

a converter for converting the phase data Φ to the control data D consisting of a plurality of control bits $D_k$, where $-1 \leqq k \leqq m-2$ (m is a positive integer).

Cont A1

7. (Currently Amended) The digital circuit according to claim 6, wherein the phase data generator generates the phase data Φ by computing an integral multiple of a unit angle Δ which is obtained from a frequency shift δ per period of the predetermined sampling clock, wherein the unit angle Δ is represented by 360° x δ, wherein the frequency shift δ is obtained by dividing the frequency difference by a frequency of the predetermined sampling clock and is represented in form of $RN/2^m$ (RN is [[an]] a rational number).

8. The digital circuit according to claim 7, wherein the converter performs a conversion operation according to the following steps:

Step 1) $k = -1$ and $\Phi_k = \Phi$;

Step 2) $D_k$ = sign bit of $\Phi_k$;

Step 3) if $k = m-2$, then exit, else go to step 4);

Step 4) $\Phi_{k+1} = \Phi_k - \theta_k$ when $D_k = 0$, and

$\Phi_{k+1} = \Phi_k + \theta_k$ when $D_k = 1$, where $\theta_k = \arctan(2^{-k})$;

Step 5) $k = k + 1$; and

Step 6) go to step 3).



97134 v1; 22Y601!.DOC

9. The digital circuit according to claim 8, wherein the signal vector rotator comprises:

a plurality of partial rotators $R_k$ which are connected in series in descending order of a rotation angle, wherein the partial rotators $R_k$ receive the control bits $D_k$, respectively, and each of the partial rotators $R_k$ rotates an output of a previous stage $R_{k-1}$ by a predetermined angle depending on a corresponding control bit received from the converter.

10. The digital circuit according to claim 9, wherein

a first partial rotator $R_{-1}$ rotates an input signal vector ($I_{in}$, $Q_{in}$) by an angle $\theta_{-1}$ to produce a first output signal vector ($I_{out,-1}$, $Q_{out,-1}$) as follows:

Cont A1

$I_{out,-1} = D_{-1} \times Q_{in}$; and

$Q_{out,-1} = -D_{-1} \times I_{in}$,

each of partial rotators $R_k$ ($0 \leqq k \leqq m-2$) rotates an input signal vector ($I_{in,k}$, $Q_{in,k}$) by an angle $\theta_k$ to produce an output signal vector ($I_{out,k}$, $Q_{out,k}$) as follows:

$I_{out,k} = I_{in,k} + 2^{-k} \times D_k \times Q_{in,k}$; and

$Q_{out,k} = -2^{-k} \times D_k \times I_{in,k} + Q_{in,k}$,

where $D_k$ uses numerical value representation such that a numerical value "1" is represented by a logical value "1" and a numerical value "-1" is represented by a logical value "0".

11. The digital circuit according to claim 9, wherein the signal vector rotator rotates an input signal vector ($I_{in}$, $Q_{in}$) having an absolute value $Z_{in}$ by an angle Θ while the absolute value $Z_{in}$ becomes $Z_{out}$, where Θ and $Z_{out}$ are represented as follows:

$$\Theta = D_{-1} \times 90^\circ + \sum_{k=0}^{m-2} D_k \bullet \arctan(2^{-k}) \text{ and}$$

$$Zout = \frac{Zin}{\prod_{k=0}^{m-2} \cos\theta_k} .$$

12. A digital demodulator for use in a multi-carrier CDMA (code division multiple access) communication system, for shifting two carrier bands of input signal vectors to a center carrier band to produce an output signal vector for each carrier band, wherein each of the input signal vectors is determined by a pair of I (in-phase) and Q (quadrature) components on I-Q plane, comprising:

Cont A1

a quadrature frequency converter for converting a received high frequency signal to analog signal vectors having I component and Q component;

an analog-to-digital converter for converting the analog signal vectors to the input signal vectors according to a predetermined sampling clock;

a control data generator for generating control data from a frequency difference between each of the plurality of frequency bands and the predetermined center frequency band;

a signal vector rotator corresponding to each of the plurality of frequency bands, for rotating the input signal vectors on the I-Q plane by an angle determined depending on corresponding control data to shift the frequency bands of the input signal vectors to the predetermined center frequency band; and

a band-pass filter corresponding to the signal vector rotator, for receiving an output of the signal vector rotator and passing an output signal vector of the predetermined center frequency band.

13. A method for shifting a frequency band of a signal vector to a predetermined frequency band, wherein the signal vector is determined by a pair of I (in-phase) and Q (quadrature) components on I-Q plane, comprising the steps of:

generating control data from a frequency difference between the frequency band and the predetermined frequency band; and

rotating the signal vector on the I-Q plane by an angle determined depending on the control data to produce an output signal vector in the predetermined frequency band.

Con'd A1

14. A method for shifting a plurality of frequency bands of input signal vectors to a predetermined center frequency band to produce an output signal vector for each frequency band, wherein each of the input signal vectors is determined by a pair of I (in-phase) and Q (quadrature) components on I-Q plane, comprising:

converting analog signal vectors to the input signal vectors according to a predetermined sampling clock;

generating control data from a frequency difference between each of the plurality of frequency bands and the predetermined center frequency band;

rotating the input signal vectors on the I-Q plane by an angle determined depending on corresponding control data to shift the frequency bands of the input signal vectors to the predetermined center frequency band; and

filtering frequency bands other than the predetermined center frequency band from an output of the signal vector rotator to pass an output signal vector of the predetermined center frequency band.